Polycold® Portable Cryocooler Model P-102

Operator and Installation Manual

Part Number 174320

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Preface

Regulatory Compliance

The Polycold Cryocooler P-102 meets the requirements of the European Union's Machinery Directive (2006/42/EC). The Low Voltage Directive (2006/95/EC) and the EMC Directive (2004/108/EC), Brooks Automation has issued a Declaration of Conformity and the Polycold Cryocooler P-102 has a CE mark affixed.

A Declaration of Conformity was sent with your Polycold Cryocooler. If you no longer have this document, please contact TechSupport@brooks.com. Below is a sample of a Declaration of Conformity.

BROOKS AUTOMATION	**Declaration of Conformity** **According to EU Directive 2006/42/EC Annex II 1.A**	**Document #:** **177612** **Rev.: A**

Description Polycold® Cryocooler
Model Number: P-102
Serial Number:

Function: Provides cryogenic cooling to an attached baffle or probe for use in a vacuum system for process control applications

Business name and full address of the manufacturer of this machinery:
Brooks Automation Inc., 15 Elizabeth Drive, Chelmsford, MA, USA 01824

Name and address of the person, established in the Community, authorized to compile the relevant technical documentation:
Brooks Automation (Germany) GmbH, Göschwitzer Straße 25, 07745 Jena, Germany

The manufacturer declares:

- That this machinery fulfills all the relevant provisions of the Machinery Directive 2006/42/EC
  - EN 60204-1
- That this machinery fulfills all the relevant provisions of the Low Voltage Directive 2006/95/EC
  - EN 61010-1

Brooks Limited Warranty

Polycold® Systems Cooling Products, CryoTiger®,AquaTrap®, Polycold Compact Cooler, Repair Services and Certified Refurbished Products

Polycold® Systems cryogenic cooling products, including water vapor cryopumps (PFC, PCT, FLC, FI), chillers (PGC, PGCL), cryocoolers (P), CryoTiger, AquaTrap, Polycold Compact Cooler (PCC) and accessories, Certified Refurbished products (the "Products") and Repair Service (i.e.- repairs other than warranty repairs) are warranted to be free from defects in materials and/or workmanship under normal service for the time period as set forth in Table A below from date of shipment from Brooks Automation, Inc. ("Brooks"). The warranty for Repair Service and Products is limited to the component parts replaced or repair performed by Brooks at Brooks' facility. Customer is responsible for all charges and expenses for Brooks Services provided at Customer's location by Brooks technicians as set forth in a quotation. Certified Refurbished Products and warranty exchange Products are remanufactured to like-new condition and contain used parts and materials.

Table A

Product	New Product Warranty	Repair Service Warranty	Certified Refurbished Cryogenic Cooling Products Warranty
Cryotiger® Products and Systems AquaTrap® Products and Systems Polycold® Compact Cooler (PCC)	15 Months	12 Months	N/A
Cryogenic cooling products, including: Water vapor cryopumps (PFC, PCT, FLC, FI), chillers (PGC, PGCL), cryocoolers (P), and accessories	24 Months	12 Months	12 months

BROOKS MAKES NO OTHER REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO PRODUCTS OR SERVICES. UNLESS EXPRESSLY IDENTIFIED AS A WARRANTY, SPECIFICATIONS IN ANY PRODUCT DATASHEET CONSTITUTE PERFORMANCE GOALS ONLY, AND NOT WARRANTIES. BROOKS MAKES NO WARRANTY RESPECTING THE MERCHANTABILITY OF PRODUCTS OR THEIR SUITABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR USE, OR RESPECTING INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. **BROOKS DISCLAIMS ANY WARRANTY WITH RESPECT TO PRODUCTS MODIFIED WITHOUT BROOKS' WRITTEN CONSENT, REPAIRS MADE OUTSIDE OF OUR FACTORY, PRODUCTS RENDERED DEFECTIVE BY CUSTOMER MISUSE, NEGLIGENCE, CORROSIVE ATMOSPHERES, ATTACK BY FREE CHEMICALS WITHIN THE SYSTEM, ACCIDENT, DAMAGE BY CUSTOMER OR CUSTOMER'S AGENT, OPERATION CONTRARY TO OUR RECOMMENDATION, IF THE SERIAL NUMBER HAS BEEN ALTERED, DEFACED OR REMOVED, THE USE OF SERVICE REPLACEMENT REFRIGERANTS FROM ANY THIRD PARTY NOT LICENSED BY BROOKS, OR THE PRODUCT IS OTHERWISE COMPROMISED BY USE OF UNAUTHORIZED PARTS OR SERVICE, ALL AS DETERMINED BY BROOKS IN ITS SOLE DISCRETION.**

IN NO EVENT WILL CUSTOMER BE ENTITLED TO, NOR WILL BROOKS BE LIABLE FOR INDIRECT, SPECIAL, INCIDENTAL, PUNITIVE OR CONSEQUENTIAL DAMAGES OF ANY NATURE, INCLUDING WITHOUT LIMITATION NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE, ARISING AT ANY TIME, FROM ANY CAUSE WHATSOEVER, INCLUDING, WITHOUT LIMITATION, DOWN-TIME COSTS, DATA LOSS, DAMAGE TO ASSOCIATED EQUIPMENT, REMOVAL AND/OR REINSTALLATION COSTS, REPROCUREMENT COSTS, OR LOST PROFITS, EVEN IF BROOKS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, AND EVEN IF THE LIMITED REMEDIES OF REPAIR OR REPLACEMENT FAIL OF THEIR ESSENTIAL PURPOSE. THIS WAIVER OF LIABILITY DOES NOT APPLY TO EITHER BROOKS' LIABILITY UNDER A STATUTE, ACT OR LAW PERTAINING TO BODILY INJURY, OR TO ANY LIABILITY INCURING OUT OF DAMAGE TO THE BODY, HEALTH OR LIFE OF A PERSON.

The exclusive remedies for breach of warranty will be either repair or replacement of the nonconforming parts or Products during the warranty period at the sole discretion of Brooks, shipped ExWorks (Incoterms 2000) Brooks factory. Customer's recovery from Brooks for any claim shall not exceed the amount paid by customer to Brooks for the Product or Service giving rise to such claim, irrespective of the nature of the claim, whether in contract, tort, warranty, or otherwise. Customer must inspect the Products within a reasonable time upon receipt, and must notify Brooks within 30 days of discovering a defect. Every claim on account of defective material or workmanship shall be deemed waived unless made in writing within the warranty period specified above. Brooks does not assume, or authorize any other person to assume, any other obligations or liabilities in connection with the sale of the Products.

All Polycold Products are also subject to the Brooks Automation, Inc. General Terms and Conditions, Polycold® Products, an excerpt of which is set forth above.

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Limitations

This product is intended for use by industrial customers and should be serviced only by Brooks or Brooks trained representatives. The service manuals and related materials are provided in English at no charge and are intended for use by experienced technicians. It is the responsibility of the user to obtain and assure the accuracy of any needed translations of manuals. If you require assistance please contact Brooks service department. Contact information can be found at www.brooks.com.

1. Introduction

System Summary

The Polcold® P-102 Portable Cryocooler provides compact, portable, and easy-to use alternatives to liquid nitrogen used in small vacuum systems. These cryogenerators use refrigerants in a closed loop system. The refrigerants are:

- Safe
- Non-flammable
- Non-toxic
- HCFC-free

This means there is no moving of heavy liquid nitrogen dewars. Also, there is no running out of cryogen causing downtime.

Installation is quick and easy. Either a cold probe is inserted into a housing or a chevron baffle is installed between a diffusion pump and a high vacuum valve. The cold probes and chevron baffles are referred to as cryosurfaces. These are part of the refrigerant line. Removing them causes a loss of refrigerant.

Cold trapping applications include:

- Helium mass spectrometer leak detectors
- Chevron baffles for diffusion pumps up to 6 inches (160 mm) in diameter
- Vapor trapping cold probes that protect mechanical pumps on small vacuum systems.

Basic Principles of Operating for the Polycold Refrigeration Cycle

This cooling process is an auto cascade refrigeration system. A patented mixture of non-flammable and safe CFC-free and HCFC-free refrigerants is compressed and circulated by a compressor. In a simplified version, the Polycold refrigeration cycle comprises:

1. Compressing a mixture of refrigerants

2. Partially condensing the higher boiling fractions in an air-cooled condenser

3. Separating and throttling the liquid condensate produces cooling that condenses the remaining vapors in a special heat exchanger. In the process of providing cooling in the Cryocooler, this mixture is partially evaporated.

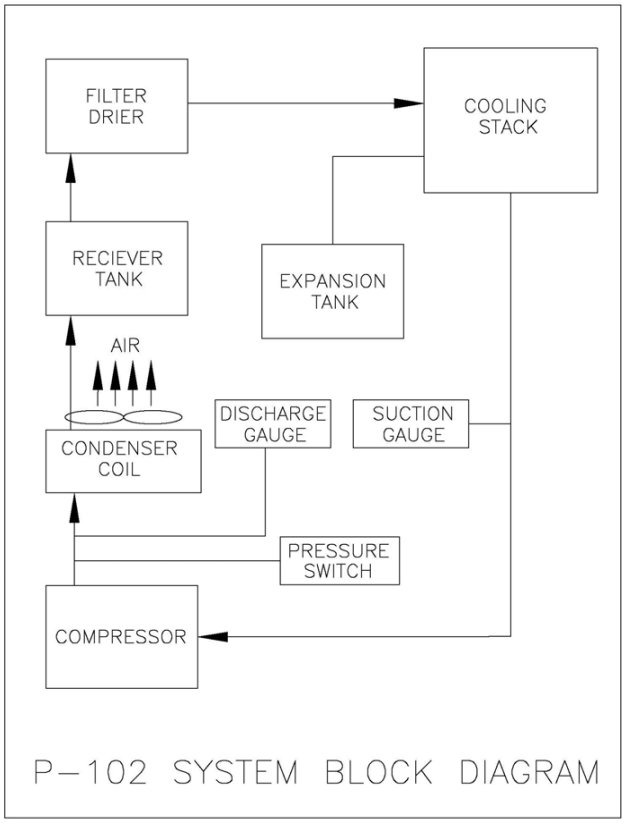
4. Throttling this latter condensate and feeding the cryocoil to produce cooling at very low temperatures

5. Passing the refrigerant leaving the cooling coil back through the heat exchanger to the compressor.

Operating pressures and compressor temperatures are similar to those in air-conditioning systems. The compressor lubricating oil circulates with the discharge vapors. The oil promptly returns to the compressor without reaching the very low temperature portions of the system. This eliminates the common problems of oil plugging in evaporators and expansion devices too often seen in low temperature systems.

The mixed refrigerant charge is hermetically sealed into the system. Normally neither the refrigerant nor the compressor lubricating oil requires replacement or recharging.

In this unit, there is a series of intermediate special heat exchangers called cascade condensers. These are located between the air-cooled condenser and the final cooling coil (cold probe). There are multiple stages of partial condensation, phase separation, condensate throttling, and intermediate cooling. In addition, the system has a suction-side refrigerant vapor expansion tank and a discharge-side receive tank to limit start-up discharge pressures.



System Components

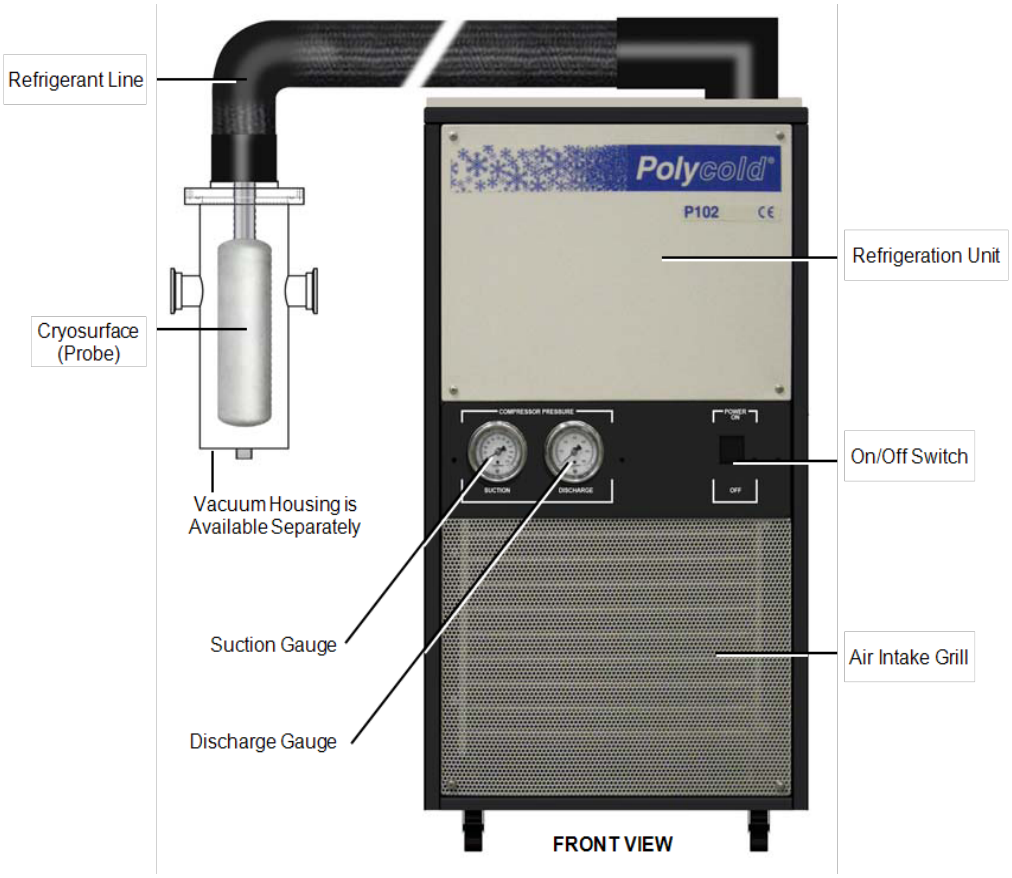


Figure 1-1: P-102 Croyocooler

Specifications of the System

Physical Specifications

NOTE: *All specifications are for the standard product configuration, specifications can vary for customized configurations.*

Table 1-1: Physical Specifications

Physical Property	Value
Dimensions: Width Depth Height (From floor, including casters, to top of frame)	 445 mm (17.5 inches) 521 mm (20.5 inches) 845 mm (33.25 inches)
Weight, with lines:	82 Kg (180 lb)
Flex line length:	1778/1752.6 mm (70/69 in) (Standard 5 foot flex line)
Cooling:	Forced air
Temperature at Heat Load:	-135° C with no load. And -110° C with 120W load
Initial cool down Time:	1.5 hr
Baffles: Chevron Baffles, Opaque, low-profile, spool piece style	• 4-inch cold bath, nominal 4-inch chevron baffle • 6-inch cold bath, nominal 6-inch chevron baffle
Cold Probes	• Trap housing for mechanical pump traps • Cold probe, stainless steel, “Easy Clean” • Cold probe, nickel plated copper with coil on exterior of mandrel

Operating Specifications

Table 1-2: Operation Specifications

Property	Specification
Ramp Time to Temperature: (No applied load)	Room temperature to -110° C (-166° F) in about 45 minutes Room temperature to -125° C (-193° F) in about 80 minutes
Operating Temperature	Ambient room temperature of 15 - 30° C (59 - 86° F)
50Hz Operation	Temperature will be approximately 5°C Warmer
Noise (maximum)	69 db(A) at 1m from the unit

Moving the Product

The Polycold Cryocooler P-102 rolls across smooth floors on four casters. Be sure there are no objects in the path as you roll the unit. Rolling across objects or wiring creates a tip hazard. Rolling up or down ramps also creates a tip hazard.

The casters have no locking device. Use proper care when moving the P-102. Position the Cryocooler in a way it can not accidently be moved to an improper location.

Safety Alerts, Equipment Alerts, and Add Info Formats

This manual and the Polycold Portable Cryocooler P-102 uses the following conventions for notifying the user about personal or equipment safety. This chapter shows the alerts used on the equipment and the locations of the alerts on the equipment.

Alert Signal Word Definition

The following are definition of the four levels of alerts as defined by ANSI and SEMI. The most serious is listed first. DANGER, WARNING, and CAUTION are defined by the level of personal injury. NOTICE only applies to possible equipment or material damage.

Table 1-3: Signal Word Definitions

Signal Word	Definition
DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.
WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	Indicates a situation which, if not avoided, could result in property damage.

Alert Colors

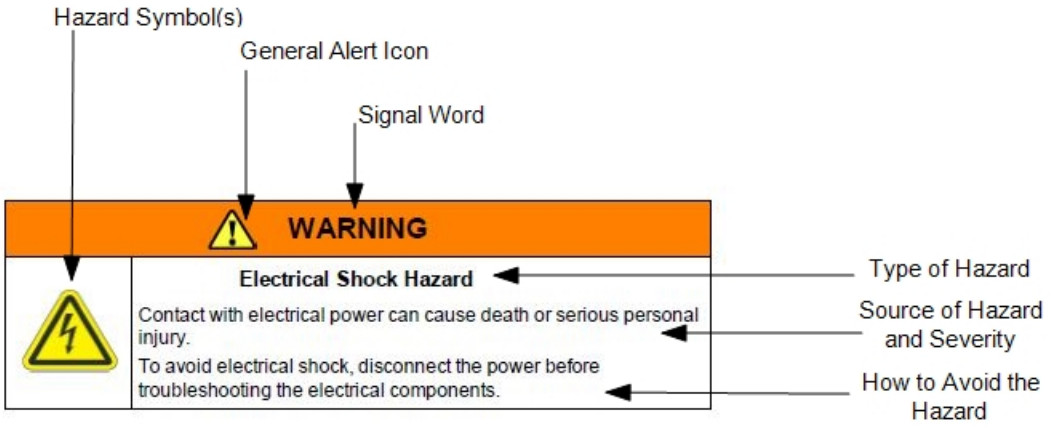
Table 1-4: Colors of Signal Word Panels

Signal Word	Color of Signal Word Panels and Backgrounds
DANGER	Background: Red Signal Word: White General Icon in the Signal Word Frame: Yellow with Black frame and exclamation point 

Signal Word	Color of Signal Word Panels and Backgrounds
WARNING	Signal Word: Black Background: Orange General Icon in the Signal Word Frame: Yellow with Black frame and exclamation point ⚠ WARNING
CAUTION	Signal Word: Black Background: Yellow General Icon in the Signal Word Frame: Yellow with Black frame and exclamation point ⚠ CAUTION
NOTICE	Signal Word: White Background: Blue The signal word area of the alert does not contain an icon. The text area may include icons that are not intended for personal safety. NOTICE

Alert Example

The following is an example of a WARNING alert.



Use of Notes

Notes are used throughout the manual to make the user is aware of additional information or to explain important information. Information in notes is not related to human or equipment safety. A note does not use icons. The following is an example of a Note.

NOTE: *Save all shipping materials for possible future use. If you return the P-102 to Polycold Systems for service or ship it to another location, the original shipping crate must be used.*

Safety and Equipment Considerations

These the following are basic guidelines. If the facility additional safety guidelines, follow those as well. Also follow all national and international safety codes that apply.

Equipment Guidelines

The following guidelines aid in the use and service of the Polycold Cryocooler P-102.

- Brooks Automation Technical Support issues a Technical Support Bulletin (TSB) to notify the owners of record of any field retrofits.
- Contact Brooks Automation Customer Support for information about repair and maintenance service policies, both during the production of the product and after production is discontinued.
- Any user caused damage during the assembly of the product into their equipment is the user's responsibility.
- Polycold System's responsibility for work performed by Polycold/Brooks authorized technicians or for equipment transported or resold by the owner of record is determined on a case-by-case basis by Brooks Automation Technical Support.
- Any parts being returned to Polycold are to be packaged according to the instructions provided with the replacement part. Packing instructions for shipping the Cryocooler P-102 are provided.
- Only qualified, properly trained persons should perform any procedures on the product. Damage that results from not properly performing a procedure or not following cautions and notices is not covered under warranty or service agreements.

Personnel Safety Guidelines

The Brooks Automation, Inc. Polycold Systems P-102 may provide several direct safety hazards to personnel if not properly installed or operated.

- Persons operating the product should be properly trained.
- Possible injury can result from the automatic operation of the product if the covers are removed.
- Wear the following safety equipment according to the manufacturer's instructions before you to install or service the P-102:
    - Eye protection
    - Gloves
- Observe the facility guidelines pertaining to loose clothing while working around or operating the P-102.
- Read and understand the Material Safety Data Sheets (MSDS) for each chemical used with the product. These individual sheets are provided in "Material Safety Sheets" on page I.
- It may be recommended that the use of hazardous materials, such as cleaning fluids, be used during routine maintenance procedures. Read and understand the facility's MSDS (provided by the manufacturer) for each substance.

- Ensure the product has been properly decontaminated before performing any service. Following the facilities' decontamination procedures. Follow all facility and regulatory procedures for the disposal of any hazardous materials.
- Ergonomic hazards may exist when moving the P-102.
- Know the locations of Hazardous points on the P-102.

WARNING	
	**THERMAL HAZARD** Do not come in contact with the probe or baffles while they are cold. Frost bite or other contact could cause personal injury. Wait at least 90 minutes after the P-102 is turned off before allowing the probe or baffles to touch your body. The probe is to be at +10° C (50° F) before any person touches the probe.

- The probe is to be at +10° C (50° F) before any person touches the probe. When removing the probe from the vacuum housing protect yourself from contact with the cold probe when handling.
- Allow the cold probe to warm up for at least 90 minutes by which time it should be at +10° C (50° F). If signs of frost are still evidenced, then wait until all signs of frost are gone. If you must handle the probe before then, use appropriate personal protective equipment needed to protect against frostbite hazard.

Equipment Safety Guidelines

The following safety considerations aid in the placement and use of the Cryocooler. down the equipment during installation as needed.

- The product is not provided with an Emergency Off (EMO) circuit. The user is accountable for the EMO circuit.
- Do not place the product's electrical connection or cold head line where they could cause a trip hazard.
- Do not place the product in a location where it may be subject to physical damage.
- Ensure that all power connections to the product are properly grounded.
- Ensure that the product receives proper air flow for cooling.
- Do not remove safety labels or equipment identification labels.
- Turn OFF power before inserting or removing power cables.
- Be aware of the hazardous points of the product as described in this chapter.
- Use of the P-102 for any purpose other than as a cryocooler is not recommended and may cause damage to the product or the equipment to which it is connected.
- Always operate the Cryocooler P-102 with the protective covers in place.
- Do not install or operate the product if it has been dropped, damaged, or is malfunctioning.
- Do not immerse cables or connectors in liquid.
- Keep cables and connectors away from heated surfaces.
- Do not modify the connectors or ports.

Safety Labels and Safety Label Identification

Labels

Safety labels and identification labels are placed on the Cryocooler P-102. These labels provide information for operators and service personnel to identify hazards. Some labels inform the user about the product. This section describes each label and identifies its location. Safety labels give instructions on how to avoid the hazard.

Label Identification and Location

Table 1-5 lists the labels that are affixed to the P-102. These labels alert personnel to hazards on or within the product. They also provide information about the product.

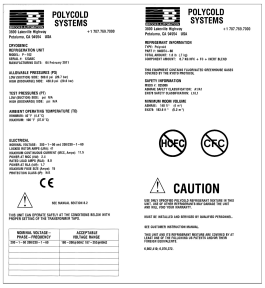
	Hazard: Mechanical Motion Qty: 2 Location: One on the fan shroud, half way up the side. One on the base plate on the side of the fan that is not shrouded. Hazard Type: CAUTION Possible Injuries: Damage to fingers How to avoid the hazard: Keep hands away from the fan.
	Hazard: Electrical Hazardous Voltage Qty: 1 Location: Panel in front of where the terminal block mounts inisde the P-102 Hazard Type: WARNING Possible Injuries: Electrical Shock or Burn How to avoid the hazard: Lockout/Tagout before servicing
	Hazard Type: Electrical High Voltage Qty: 2 Location: One on the compressor electrical box cover. One on the upper corner of the right side cover within which the terminal strip is mounted. Hazard Type: WARNING Possible Injuries: Electrical Shock or Burn How to avoid the hazard: Lockout/Tagout before Servicing. Servicing by qualified personnel
	Serial Label Qty: 1 Location: Lower right corner of upper real panel. Hazard Type: N/A Possible Injuries: N/A How to avoid the hazard: N/A

Figure 1-2 shows the location of each label. To replace a lost or damaged label call Brooks Automation Technical Support.

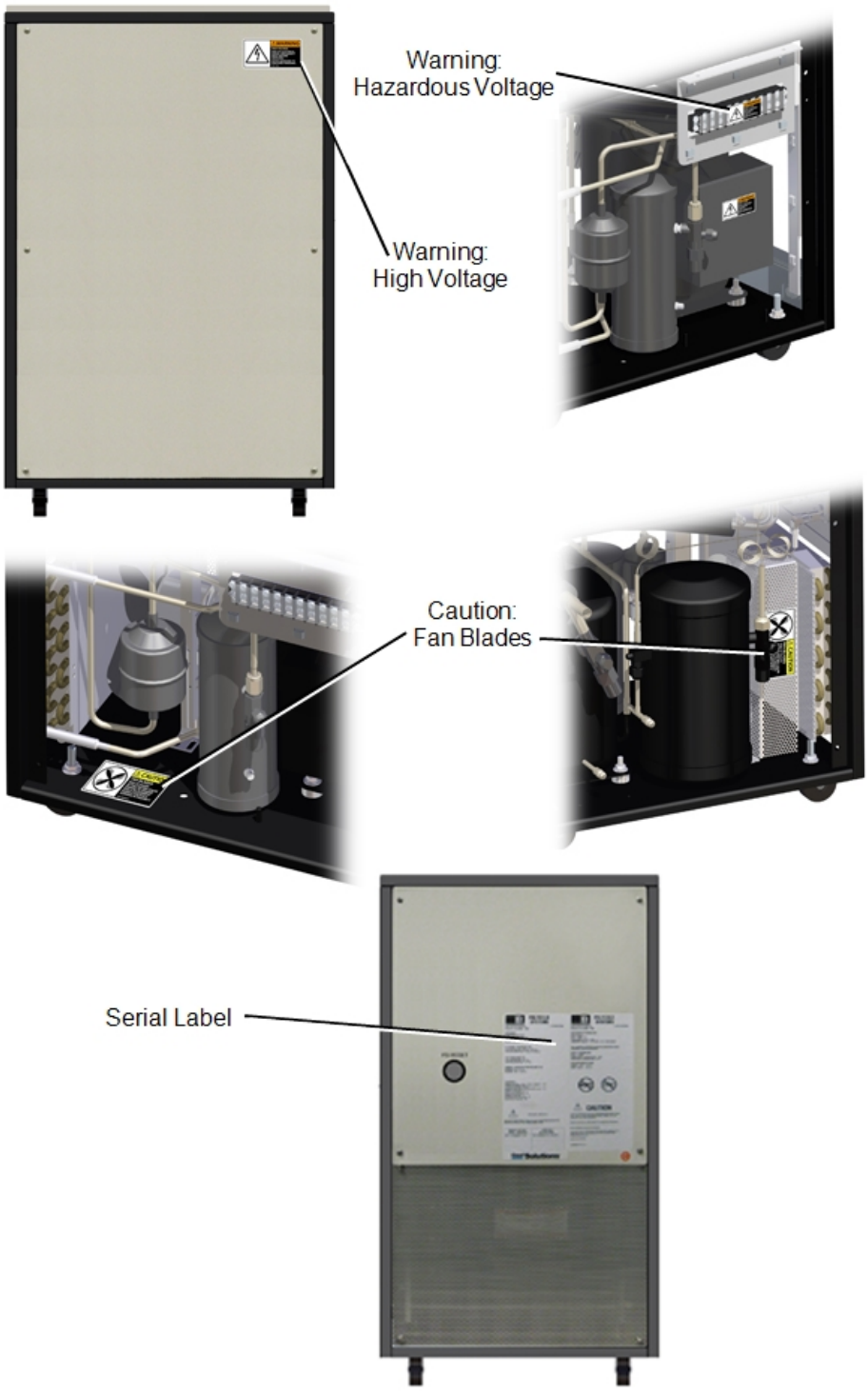


Figure 1-2: Locations of Labels on the P-102

Mechanical Hazards

The Polycold P-102 is a mechanical device. The P-102 contains a fan to air cool the condenser. Do not operate the P-102 without the protective covers.

NOTE: *Only persons with the proper training are to service or operate the product.*

Use Safety glasses and gloves when working on or near the P-102.

WARNING	
	Whenever power is applied the fan automatically turns on. There are no obstruction sensors and movement could result in personal injury. Do not operate the P-102 without the protective covers in place.

CAUTION	
	**Heavy Object Hazard** The Product weighs 82 kg (180 lb). Do not attempt to lift the P-102 without a forklift. Roll the P-102 across smooth floors.

CAUTION	
	**Tip Hazard** Tip hazard exists when moving the P-102 up or down a ramp. Be sure to prevent the P-102 from tipping when using a ramp.

CAUTION	
	**Trip Hazard** Trip hazard exists if the power cord is not routed to in a way to cause a trip hazard. Route the cord in an area where there is no travel.

Electrical Hazards

The Brooks Automation, Inc., Polycold Systems P-102 is a high voltage device. At maximum load the product is capable of drawing close to 11.5 Amps at 200 - 230 VAC VDC. Maximum power consumption @ rated load for this product is 1620 watts. The minimum overcurrent ratings for disconnects requires a user installed 230 VAC, 20 A, minimum SCCR rating of 10 KIAC.

The proper precautions for operating and servicing electrical equipment must be observed.

WARNING	
 	**Electrical Hazard** The P-102 is a high voltage device. Turn off power and perform Lockout/Tagout before servicing. Improper electrical connection and connection to an improper electrical supply can cause electrical hazards. Improper handling of the power source or connecting devices can cause electrical shock or burns. These can result in serious injury or death or cause an equipment fire and damage to the equipment. Always provide the product with the proper electrical code compliant connections.

Environmental Hazards

Noise

The Brooks Automation Product provides no direct noise hazard.

Vibration

The Brooks Automation Product provides no direct vibration hazard. Any vibrations produced are minimal and cause no hazardous conditions.

Recycling and Disposal Information

The Brooks Automation Product contains refrigerant that may requires special handling for disposal or recycling.

Refrigerant

A qualified refrigeration technician is needed to remove the refrigerant from the P-102. Follow all facility and regulatory procedures for the disposal of hazardous materials.

Disposal of the P-102 When Decommissioning

Follow all facility and regulatory procedures for the disposal of hazardous materials.

WARNING	
	**CHEMICAL HAZARD** Whenever any cleaning fluid is used during service of the P-102, the facility's environmental procedures must be followed regarding the storage, handling, and disposal of that fluid.

Thermal Hazard

The condenser and compressor inside the P-102 become hot during operation. Wait 90 minutes after you perform Lockout/Tagout according to the facility procedures before removing any covers.

WARNING	
	**THERMAL HAZARD (hot)** Hot surfaces can cause burns and personal injury. Do not operate the P-102 without all covers in place. Wait 90 minutes after performing Lockout/Tagout according to the facilities procedure before removing any cover.

The probe is to be at +10° C (50° F) before any person touches the probe. When removing the probe from the vacuum housing protect yourself from contact with the cold probe when handling.

Allow the cold probe to warm up for at least 90 minutes by which time it should be at +10° C (50° F). If signs of frost are still evidenced, then wait until all signs of frost are gone. If you must handle the probe before then, use appropriate personal protective equipment needed to protect against frostbite hazard.

WARNING	
	**THERMAL HAZARD (cold)** Do not come in contact with the probe or baffles while they are cold. Frost bite or other contact could cause personal injury. Wait at least 90 minutes after the P-102 is turned off before allowing the probe or baffles to touch your body.

Reference Document:

ISO 13732-3, Ergonomics of the thermal environment - Methods for the assessment of human responses to contact with surfaces; Part 3: Cold Surfaces

2. Installation

Installation Requirements

The following information contains information you need for installation of the P-102.

Power Specifications

The following table includes electrical specification for the P-102.

Table 2-1: Electrical Specifications

Electrical Properties	Specifications
Voltage/Frequency/Phase (±10%)	200 VAC @ 50 Hz - Single Phase 208-230 VAC @60 Hz - Single Phase
Inrush Current	41 Amps (locked rotor amps)
Maximum Continuous Current	11.5 Amps Maximum
Rated Load Amps	7.5 Amps
Overvoltage Category	Category II
Disconnect Device	The disconnect device is customer supplied. It should be rated for minimum 10 KAIC. The P-102 is not provided with a circuit breaker or a disconnect device.

Site Requirements

The following table lists Site Specifications.

Table 2-2: Environmental Specifications

Environmental Factors	Specifications
Temperature: Ambient Air During Operation Shipping Storage 50Hz Operation	 15 – 30° C (59 – 86° F) -20 – +49° (-4 – +120° F) A room temperature of 4 – 49° C (40 – 120° F), non condensing Temperature will be approximately 5°C Warmer.
Relative Humidity	20 – 80%, non-condensing relative humidity
Lighting	Standard lighting is sufficient for proper operation. Maintenance may require a service lamp or flashlight.
Transport	The P-102 must remain in a vertical position.
Install Location	Be sure to allow 18 inches in front of and to the rear of the P-102. Well ventilated area greater than 2200 ft^3 Above ground
Service Access	The P-102 requires adequate space for service access and for proper ventilation. Typical service space required is shown in Figure 2-1 . Allow 36 inches to the left and right sides of the P-102 for service areas.
Ground Clearance	1 7/8 inches
Rolling Provision	Four casters
Lifting Provision	Use a fork lift
Hold-Down Provision	None. Determine if the P-102 is being used in an earthquake prone area. If so, the customer needs to provide tie-downs to prevent the P-102 from moving during an earthquake.

NOTE: *The facility is responsible ensuring the Cryocooler P-102 installation complies with the local electric codes.*

Service and Exclusion Zones

Place the P-102 so that the area indicated in Figure 2-1 is available for service and ventilation.

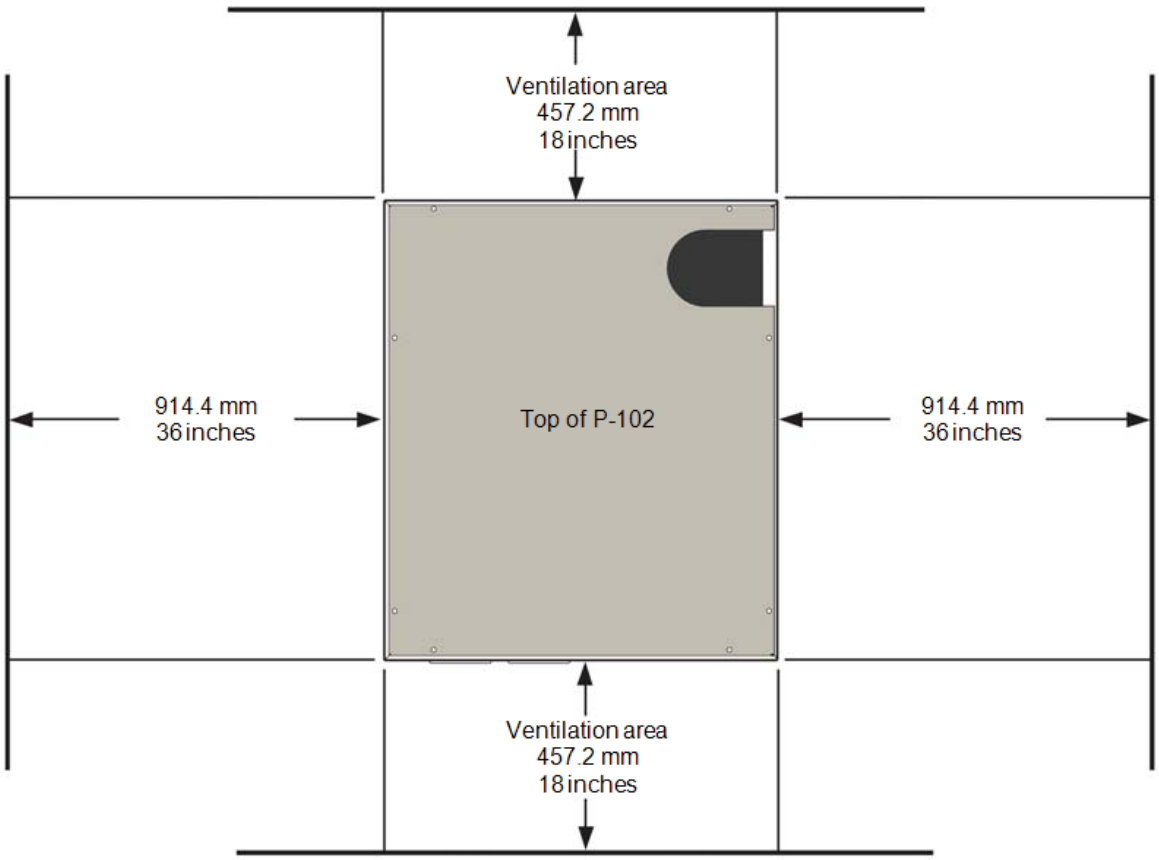


Figure 2-1: Service and Exclusion Zones

Unpacking and Inspection

Unpack the crate carefully. Inspect and verify its contents against the shipping documents. Report any damage immediately to the shipper and to Polycold Systems, Inc.

One set of shipping documents are attached to the outside of the main shipping crate for easy access. An additional set of the same documents are attached to the equipment inside the shipping crate.

NOTE: *Shipping Balance Pressure Range: 125-145 psi at 21°C (70°F) or above*

Unpacking and Moving Instructions

Tools and Materials	Fork Lift High vacuum lubricant – must have an appropriate low vapor pressure for use with an o-ring seal

Unpacking the P-102

1. Upon receiving the crate, inspect the indicators for disturbance. Also, visually verify each crate is not damaged. Inform the freight carrier and Polycold Technical Support of any inspection discrepancy.

2. Remove the cover of each shipping crate. Inspect, and verify the contents against the shipping documents. Do not remove any protective wrapping.

NOTE: *Save all shipping materials for possible future use if the P-102 is returned to Brooks Automation, Inc./Polycold Systems or shipped to another location. If the original crates have become lost or damaged, contact Polycold Systems for replacements. Refer to* *"Material Safety Sheets" on page I.*

3. Move the product to its final location.

CAUTION	
	**Heavy Object Hazard** The Product weighs 82 kg (180 lb).Failure to take the proper precautions before moving it could result in personal injury.

4. Remove the bag from the Product and carefully inspect the product for signs of damage that may have occurred during shipping.

RECYCLE	
	Recycle all packaging materials.

CAUTION	
	Safety glasses and gloves are to be worn at all times when installing the product.

5. Inspect all vacuum sealing surfaces where the cold probe or cryobaffle is to be used. The surfaces must be clean and free from scratches or other imperfections that might result in vacuum leaks. Protect these surfaces at all times.

6. Remove any contaminants by wiping them with a clean cloth moistened with alcohol.

Moving the P-102

1. Use a lift to lift the P-102 off the pallet and place it on the floor.

CAUTION	
	**Tip Hazard** Tip hazard exists when moving the P-102 up or down a ramp. Be sure to prevent the P-102 from tipping when using a ramp.

2. Roll the P-102 carefully to where the tool is to be installed. Be sure the floor is smooth and there is no tip hazard. Roll the P-102 very carefully if it must roll up or down a ramp. This may cause a tip hazard.

3. The system may be operating continuously. It should be turned off any time the fore- or roughing pump(s) are to be turned off.

Starting Up the P-102

1. Start the unit by turning on the front panel switch.

   - You can hear the compressor and condenser fans start running.
   - The Power light on the front panel lights.
   - Within about 5-10 minutes, cooling begins in the cold probe.

If the compressor turns off during initial start up, turn the switch off for 5-10 minutes, then turn the switch on again to restart the P-102.

Do not operate the unit for more than 15 minutes. This causes moisture to accumulate on the cold probe.

2. Turn off the unit.

3. Warm the cold probe.

4. Dry the cold probe.

5. Inspect all vacuum sealing surfaces where the cold probe or cryobaffle is to be used. The surfaces must be clean and free from scratches or other imperfections that might result in vacuum leaks. Protect these surfaces at all times.

6. Remove any contaminants by wiping them with a clean cloth moistened with alcohol.

7. Insert the cold probe in its the cold trap.

8. Make certain there are no sharp bends or strains on the flexible insulated line that leads to the cold probe.

9. Check the vacuum chamber where the cryobaffle is installed for leaks between the vacuum chamber and cryobaffle.

10. Rough the vacuum system down.

11. Turn on the P-102.

12. Be careful not to bend the insulated flex line much after the unit has chilled down the probe and line. This can lead to cracks in the insulation.

NOTE: *The system may be operating continuously. It should be turned off any time the fore- or roughing pump(s) are to be turned off.*

3. Operation

This chapter describes how to operate the P-102.

External Controls and Indicators

This section provides a description of the P-102 controls and indicators.

Figure 3-1: External Controls and Indicators

Table 3-1: External Controls and Indicators

Name	Function
ON/OFF Switch	Turns the P-102 power on and off
ON/OFF Switch LED	Turns on when the P-102 is turns on. Turns off when the power to the P102 turns off
Suction Pressure Gauge	Displays compressor's suction pressure
Discharge Pressure Gauge	Displays the Compressor's discharge pressure
Feed and Return Thermocouples	Type T thermocouples showing refrigerant temperatures feeding and returning from the probe or baffle. The Return thermocouple is shipped with a knot tied in the wire while the Feed is shipped without this knot. ***NOTE:*** *Temperature meter should be set for Type-T thermocouples.*

Powering Up the P-102

1. Be sure the facilities power supply is correct for the P-102.
2. Plug the P-102 into the facilities power supply.
3. Turn on the power switch on the P-102.

   You will observe the following:

   - Audible noise from the fan
   - Audible noise from the compressor
   - Light on the power switch lights

4. Check the vacuum chamber where the cryobaffle is installed for leaks between the vacuum chamber and cryobaffle.

The system may be operating continuously. It should be turned off any time the fore- or roughing pump (s) are to be turned off.

Defrosting the P-102

If vacuum pump-down times or ultimate levels degrade, the cold probe may have accumulated enough frost to affect performance.

1. Close the high vacuum valve and turn off the Cryocooler P-102 unit. The diffusion pump may be left on or turned off at the user's option.

2. Leave the fore-pump on to remove the evaporating moisture from the system.

Overnight defrosting is suggested. After defrosting, the P-102 unit can then be turned on again. Restart the diffusion pump if it also was turned off. Many applications have low moisture loads and continuous operation for months is possible without defrosting. Those systems with very heavy moisture loads may require weekly defrosting.

Compressor and Condenser Fan Motors

The compressor and condenser fan motors are lifetime lubricated and do not require regular oiling. Both the compressor and condenser have temperature switches that turn off either the fan or the compressor if the motors for either begin to overheat.

Safe Shut Down

The following shut-down procedure is used to remove power from the Cryocooler P-102.

NOTICE

This shut-down procedure is used in the normal shut-down of the Product. This procedure completely removes the power source and all other facilities to the product.

1. Turn off the facility power to the P-102 or unplug it from the disconnect.

2. Turn off the ON/OFF switch. The light on the switch turns off.

3. Observe that the sounds of the fan, and condenser stop.

Shutting the P-102 Down For Maintenance

Shutting the P-102 Down for Maintenance.

1. Be sure the P-102 is turned off. Be sure the power light to the P-102 turns off.

2. Remove the power plug from the facilities power source.

WARNING	
 	**Electrical Hazard** Electrical contact could cause death or serious injury. Always perform Lockout/Tagout according to the facility's policy before working on the P-102.

3. Perform the Lockout/Tagout procedure according to the procedure at your facility.

NOTE: *This procedure only shuts down power to the P-102. Any user equipment remains powered up.*

4. Preventive Maintenance

P-102 Maintenance

Follow the preventive maintenance procedures and schedule provided in this section. Performing preventive maintenance extends the operating life of the product. Adjust the schedule you need depending on where the Polycold Cryocooler is used.

WARNING	
	Mechanical hazards, electrical hazards, and shock hazards exist on the P-102. The procedures in this chapter should only be performed by qualified persons. Read and understand the Safety section in Chapter 1 before performing any procedure.

Parts

Polycold can provide all parts required for Preventive Maintenance. For a list of these parts, contact Brooks Automation Technical Support. Refer to Chapter 4: Parts and Service for contact information.

Preventive Maintenance Schedule and Procedures

Always perform Lockout/Tagout according to the facility procedure before removing any covers or handling the cold probe or baffle. Wait 90 minutes after Lockout/Tagout is performed before opening covers or handling the cold probe or baffle.

WARNING	
	The fan has no obstruction sensors and can cause serious personal injury. Do not operate the Product without the protective covers in place.

WARNING	
	**Electrical Hazard** The P-102 is a high voltage device. Turn off power and perform Lockout/Tagout before servicing. Improper handling of the power source or connecting devices can cause electrical shock or burns. These can result in serious injury or death or cause an equipment fire and damage to the equipment.

Table 4-1: Preventive Maintenance Schedule

Component	Maintenance Action	Frequency	Page #
Air Cooled Condenser	Cleaning	Inspect weekly for the first month, then monthly until you determine cleaning frequency	Page 26
Air Intake Grill	Cleaning	Dependent on how much dust and particles are in the surrounding area	Page 27
Cold Probe	Cleaning	Clean after the cold probe is removed during servicing. Some P-102 do not have cold probes.	Page 28

Cleaning the Air Cooled Condenser

This procedure describes how to clean the air cooled condenser.

WARNING	
	**THERMAL HAZARD (hot)** Hot surfaces can cause burns and personal injury. Do not operate the P-102 without all covers in place. Wait 90 minutes after performing Lockout/Tagout according to the facilities procedure before removing any cover.

Tools and Materials	Phillips® screw driver Brush, vacuum cleaner or compressed air blow-gun

Keep the air-cooled condenser clean enough for free air flow through it.

1. Remove power from the system and allow 90 minutes before accessing the inside of the P-102.
2. Remove the ventilated panel by removing two Phillip® screws.
3. Lift the panel away from the system.
4. Remove accumulated dirt or lint by brushing, vacuum cleaning, or with a compressed air blow-gun.
5. Attach the ventilated panel by attaching it using the two Phillips screws previously removed.
6. Inspect the condenser face about weekly for the first month then monthly thereafter to determine the cleaning frequency the ventilated panel needs cleaning.

Cleaning the Air-intake Grill

This procedure describes how to clean the air-intake grill.

WARNING	
	**THERMAL HAZARD (hot)** Hot surfaces can cause burns and personal injury. Do not operate the P-102 without all covers in place. Wait 90 minutes after performing Lockout/Tagout according to the facilities procedure before removing any cover.

Tools and Materials	Phillips® screw driver Brush, vacuum cleaner or compressed air blow-gun

Keep the air-intake grill clean enough for free air flow through it.

1. Remove power from the system and allow 90 minutes before you remove the grill of the P-102.
2. Remove the ventilated air-intake grill panel by removing two Phillip® screws.
3. Lift the panel away from the system.
4. Remove accumulated dirt or lint by brushing, vacuum cleaning, or with a compressed air blow-gun.
5. Attach the ventilated air-intake grill panel by attaching it using the two Phillips screws previously removed.

6. Inspect the condenser face about weekly for the first month then monthly thereafter to determine the cleaning frequency the ventilated panel needs cleaning.

Cleaning the Cold Probe

This procedure describes how to clean the cold probe.

WARNING	
	**THERMAL HAZARD (cold)** Do not come in contact with the probe or baffles while they are cold. Frost bite or other contact could cause personal injury. Wait at least 90 minutes after the P-102 is turned off before allowing the probe or baffles to touch your body.

Tools and Materials	Isopropyl alcohol Clean wipe or lintless cloth

1. Turn off the P-102 and unplug the unit.

2. Perform Lockout/Tagout according to the facilities procedure.

3. Wait for 90 minutes for the cold probe to return to room temperature.

4. Wipe the cold probe with isopropyl alcohol wipes until it is clean.

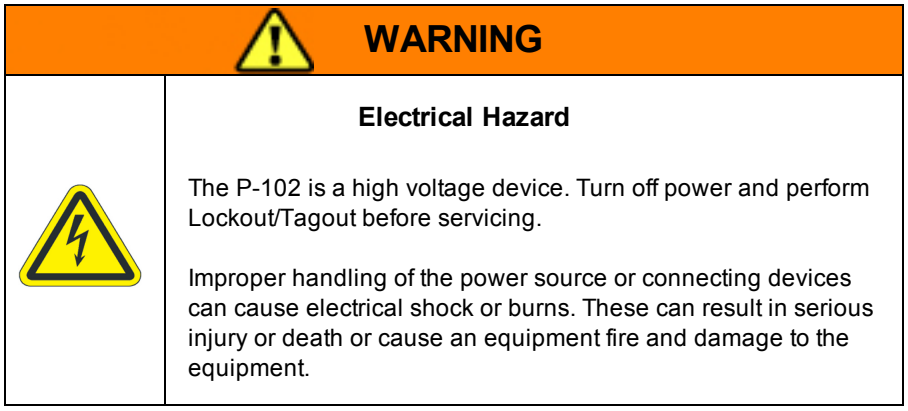
5. Troubleshooting

This Chapter describes the actions the operator can take to troubleshoot the P-102

Troubleshooting Chart

Use the following troubleshooting chart if you encounter a problem listed in the Problem section of the chart. If this chart does not help you determine the problem, contact Polycold Systems or Brooks Automation for further assistance.

If a cover needs to be removed from the P-102, you must perform the facility procedure for Lockout/ Tagout.



Internal parts, including the compressor and condenser become hot during operation. Wait 90 minutes before you remove any covers from the P-102.

WARNING

THERMAL HAZARD (hot)

Hot surfaces can cause burns and personal injury.

Do not operate the P-102 without all covers in place. Wait 90 minutes after performing Lockout/Tagout according to the facilities procedure before removing any cover.

The cold probe or baffle becomes very cold. This could cause frost bite if the probe is handled while it is cold. Perform Lockout/Tagout according to the facility requirements. When you remove the probe or baffle use proper personal protection. Before handling the probe or baffle be sure you wait 90 minutes after it has been removed and the P-102 must be locked out and tagged out for 90 minutes.

WARNING

THERMAL HAZARD (cold)

Do not come in contact with the probe or baffles while they are cold. Frost bite or other contact could cause personal injury.

Wait at least 90 minutes after the P-102 is turned off before allowing the probe or baffles to touch your body.

Reference Document:

ISO 13732-3, Ergonomics of the thermal environment - Methods for the assessment of human responses to contact with surfaces; Part 3: Cold Surfaces

Problem	Possible Cause	Corrective Action
Compressor starts and runs, but short cycles on overload protector.	Excessive discharge pressure	Check for cleanliness of the condenser. Clean if necessary. Verify the fan is working. Contact a Polycold Service Center for details if you do not hear the fan running or the problem persists.

Problem	Possible Cause	Corrective Action
Compressor stops running and does not restart.	Excessive discharge pressure	Reset the discharge pressure relay by inserting a finger through the PS1 access hole located on the back panel and pushing the green reset switch forward.  Contact a Polycold Service Center if the problem persists.
Inadequate cooling of the cold probe	Excessive heat load on the Cold Probe	Verify the probe is in proper ambient pressure (1 torr or deeper vacuum). See if there is excessive external frosting of the trap housing. Defrost the probe and retest the results. Contact a Polycold Service Center if the problem persists.

6. Parts and Service

Contacting Brooks Automation Technical Support

Have the following information ready before you contact Brooks Automation Technical Support.

1. Record the serial number.
   Provide the location of the product.

2. Provide the name of the person to contact, e-mail address, and telephone number.

3. Describe the malfunctions observed during the failure.

4. Prepare a detailed description of the events leading up to the error.

5. Include:

   - How long has the equipment been in operation?
   - Was any work done on the equipment prior to the error?
   - What command was the equipment performing when the error occurred.
   - List all actions taken after the error was performed.
   - What were the results of those actions?
   - Is their any other information that may assist our Specialist?

Polycold Customer Support Information

Polycold Customer Support:
Email: polycoldsupport@brooks.com
Tel: (800) FOR-GUTS (800-367-4887)
Fax: +1-707-769-1380

For Emergency after Hours Support

You can reach Brooks Global Customer Operations Teams around the world at the following phone numbers:

Table 6-1: Technical Support Contact Information

Location	GUTS® Contact Number
North America	+1-800-FOR-GUTS (1-800-367-4887) +1-978-262-2900
Europe	+49-1804-CALL-GUTS (+49-1804-2255-4887)
Japan	+81-45-477-5980
China	+86-21-5131-7066
Taiwan	+886-3-5525225
Korea	+82-31-288-2500
Singapore	+65-6464-1481

Refer to the Brooks Automation web site (www.brooks.com) for additional contact information.

Packing and Shipping Instructions

If the Product is to be shipped, for return to Brooks or to another location, it must be properly packaged to ensure it arrives undamaged.

NOTE: *Use the original shipping crates when shipping the P-102. If the original crates have become lost or damaged, use similar containers.*

WARNING	
	**Lockout / Tagout** The Product must be shut down and perform Lockout/Tagout according to the procedure at your facility.

Tools and Materials	All shipping materials used to ship the P-102 Desiccant packs Moisture, Shock, and Tip indicators as required Fork lift

Packing and Shipping Procedure

1. Turn off the P-102. Allow it to return to ambient temperature.

2. Unplug the P-102.

WARNING	
	**Lockout / Tagout** The Product must be shut down and perform Lockout/Tagout according to the procedure at your facility.

3. Use a fork lift to lift the P-102 onto the pallet in the shipping container.

4. Close the box and completely tape all the seams in the box shut.

5. Add tip indicators, shock indicators, moisture indicators or other indicator if necessary to the outside of the shipping container. This provides information about proper handling during shipment.

Appendix

Appendix A: Material Safety Sheets

Table 0-1 identifies the materials that are contained or shipped with the P-102. Read and understand the Material Safety Data Sheet (MSDS) for each material. These sheets provide crucial information about the materials used in the equipment. The facility where the P-102 is to be used is responsible for the maintenance and distribution of each MSDS. Ensure that the MSDSs are available in each workplace.

Inert-HFC Polycold Refrigerant not considered a hazardous material as long as it is confined in the hermetically sealed system. Be sure to be familiar with the MSDS.

Table 0-1: Hazardous Material Used in the Product

Material	Location in Product	Link
Inert-HFC Polycold® Refrigerant	Internal as a closed loop to all lines in the refrigeration cycle	PDF